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ABSTRACT

This investigation focuses on the life cycle of the yellow perch, the factors which can affect perch populations at each stage of the life cycle, and the methods used to manage Lake Erie perch populations. The investigation is presented in the form of a teachers' guide and a students' guide. It consists of two games related to the management of perch. The first game introduces the perch life cycle and forces which act on the population. The second game presents roles for the student to assume in a group planning situation for development of perch management policy for Lake Erie. An overview is given, followed by the prerequisite student background for success in the lesson. Necessary materials are listed. (Author/SA)

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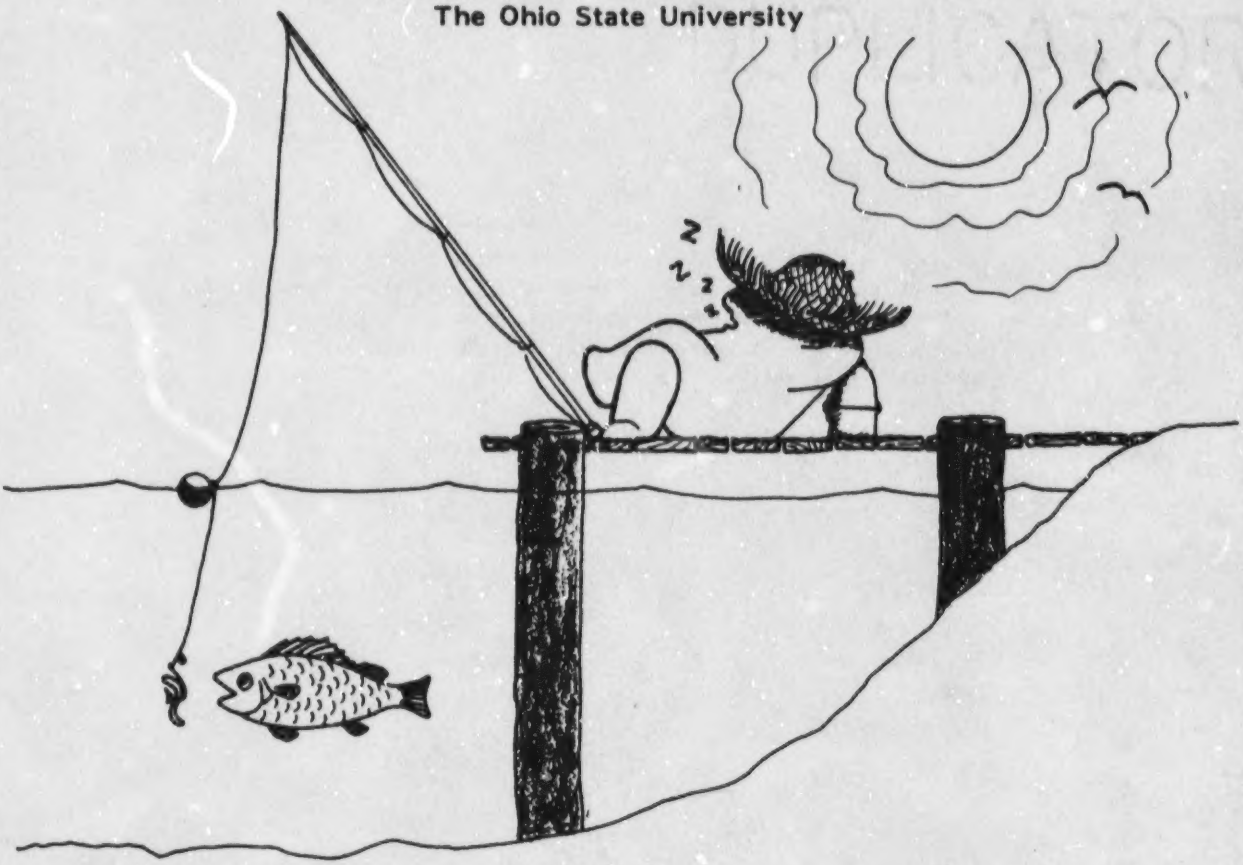
OEAGLS– Oceanic Education Activities for Great Lakes Schools

YELLOW PERCH IN LAKE ERIE

by

Rossnne Fortner and Gabriele Reil
The Ohio State University



Ohio Sea Grant Program
Charles E. Herdendorf, Program Director
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SE 028 773

OEAGLS INVESTIGATION #9

Completed May, 1979

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INVESTIGATION

YELLOW PERCH IN LAKE ERIE

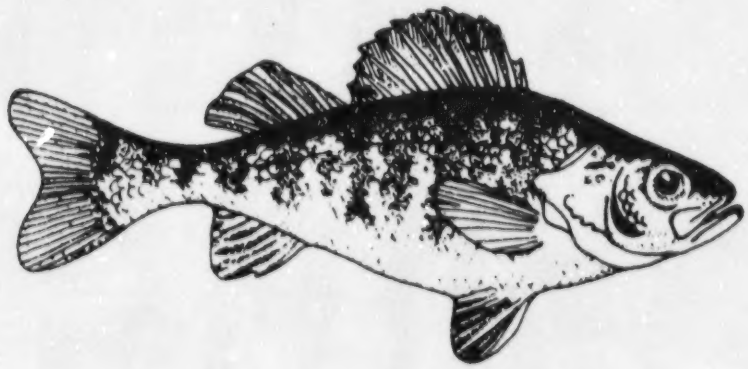
INTRODUCTION

Each spring, hundreds of yellow perch deposit their eggs on the shallow, sandy bottom near the shore of Lake Erie. A female perch can lay up to 50,000 eggs at one time. At this rate will Lake Erie soon have a population explosion of yellow perch? Why are so many eggs laid by each fish? How does nature control population size? Can man also affect fish populations?

OBJECTIVES

When you have completed these activities, you should be able to:

1. Describe the life cycle of the yellow perch.
2. Discuss the factors that can affect perch populations at each stage of the life cycle.
3. Discuss the pros and cons of some methods used to manage the Lake Erie perch population.



YELLOW PERCH
Perca flavescens
length: 10-34 cm
weight: 112-568 g
coloring: bright green to olive to golden brown on back; yellow-green, yellow on sides; grey to milk-white below
common names: perch, lake perch, American perch

Figure 1: Characteristics of Yellow Perch (Fish of Lake Michigan, University of Wisconsin, 1974).

ACTIVITY A — WHAT CAN HAPPEN TO A GROWING PERCH?

MATERIALS

Perch Life Cycle game board, spinner, place marker tokens (one per student), CHANCE cards, record sheets.

PROCEDURE

A. Object of the game: The first player to have one male and one female fish survive to spawn is the winner. Another more important object is to find out the things that can happen to perch populations. Be sure you read the information in the board spaces and on the game cards.

B. How to begin: Two to four people can play. Choose a token to represent your perch population and place it on the START space of the game board. Each population begins with 50,000 eggs.

The person with the highest total on two spins of the spinner plays first. The one with the next highest total goes second, and so on. CHANCE on the spinner counts as zero.

C. How to play: When your turn comes, spin the spinner and move your token clockwise the number of spaces indicated. If the spinner points to CHANCE or if you land on a space marked CHANCE, draw a CHANCE card from the top of the deck and follow the instructions on it. If the card does not say "KEEP THIS CARD" place it back on the bottom of the deck before the next player's turn. NOTE: CHANCE cards refer to fish, not to eggs. If you spin a CHANCE before your eggs hatch, spin again.

As you play, record the size of your perch population on a record sheet. In most cases, males and females are added together to get the population size, but some events affect only one sex of the fish. Unless you are told to do differently, assume that half of your fish are females and half are males (see "hatching" space).

D. Losing all your perch: If the space you are on or the CHANCE card drawn cause you to lose more fish than you have on your record sheet, your population has been wiped out. Depending on where you are on the board, this can have two different effects.

(1) If your eggs have not hatched when they are all wiped out, go back to START and begin all over again with 50,000 eggs.
(2) After the eggs hatch, your population is expected to be on its own. If you lose all your fish, you are out of the game.

E. Winning the game: The first person to land on the SPAWN square with at least one male and one female is the winner. If all players but one are wiped out, the remaining player is still not the winner until his/her fish make it to spawning. If no fish make it to spawning, your team may start the game over again.

F. When the game is over: Using the game board spaces and the CHANCE cards, complete the game chart in Figure 2 and answer the following questions.

1. Why is it an advantage to the yellow perch to lay so many eggs?_____

_____

2. In which part of the perch life cycle are the most animals lost?

_____

3. At what age does a perch become sexually mature?_____

4. What destroys most of the perch that become mature?_____

_____

5. In what ways could the numbers of perch be increased?

_____

_____

_____

4

6. Could factors like those that affect perch in Lake Erie also affect fish in the ocean? _____
Do you think that these factors have as big an effect on fish in the ocean ?_____ Explain your answer.

_____

_____

PERCH POPULATION RECORD

Player _____

Token				
Size Of Population				

Calculating Space

FACTORS AFFECTING PERCH

Stage of Life Cycle	Natural Factors	Add(+) or lose(-) population	Man-made Factors	Add(+) or lose(-) population
Eggs (use no CHANCE cards)				
Young Perch (hatching to 2 years)				
2-3 Year Old Perch				
Mature Perch				

Figure 2: Game Chart

ACTIVITY B

HOW CAN THE PERCH FISHERY BE MANAGED?

Now that you have learned of the many things that can happen to a population of perch, you know why it is sometimes necessary to make rules to protect them. The organization responsible for making and enforcing those rules is the U.S. Fish and Wildlife Service. The FWS works closely with state agencies such as Ohio's Division of Wildlife to produce the best plan for managing the animals.

PROCEDURE

Many people and organizations are affected by a fishery management policy. The interested groups all want the policy to benefit them. Your teacher will assign you to represent one of these interest groups:

U.S. Fish and Wildlife Service
Commercial Fishers Co-Op
Sport Fishers
Urban Development League of Ohio
Save the Perch
Consolidated Ohio Power Company

Study your role description and be prepared to try to convince others that what your group wants would really be the best for everybody. Your activity schedule will be:

1. Meet with representatives of the other interest groups. The FWS representative will explain what the agency proposes to do to manage the perch population. Explain why you are for or against the proposals and present a policy that you wish the FWS to enforce.

2. Within your working group, reach a decision about the best proposal, or write a new one. Give this to the FWS person as your group's recommendation.

3. All FWS representatives meet and choose the best perch management policy. While they are meeting, all the interest group representatives write letters to the people they represent, telling how they have worked for the group's cause and what the results have been so far.

4. The FWS announces what its new perch management policy will be. FWS representatives answer any questions from the interest groups. Record the FWS decision here:

5. Was this decision fair to all parties concerned? _____If not, what interest groups would suffer because of the new policy? Explain.

6. Will the new policy produce the optimum sustained yield of perch in Lake Erie?_____Explain.

PAGE 9 "1977 LAW HAS INCREASED COD, HADDOCK AND THE COMPLAINTS OF U.S. FISHERMEN" FROM THE COLUMBUS DISPATCH NEWSPAPER
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YELLOW PERCH IN LAKE ERIE

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TEACHER GUIDE

OEAGLS INVESTIGATION #9
Completed March, 1979

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INVESTIGATION

YELLOW PERCH IN LAKE ERIE

OVERVIEW

This investigation consists of two games. Activity A is a board game designed to introduce the stages of the perch life cycle and the forces affecting the perch population at each stage.

Using information gained in Activity A, students participate in a role-playing situation in Activity B. Various interest groups provide input on the development of a perch management policy for Lake Erie.

PREREQUISITE STUDENT BACKGROUND

Basic mathematical skills: addition, subtraction, and division by 2.

MATERIALS

Perch Life Cycle game board, spinner, place marker tokens (one per student), and CHANCE cards, all constructed using patterns in this guide; record sheets (in Student Guide); paper clip; paper fastener; six role descriptions.

OBJECTIVES

When students have completed this investigation, they should be able to:

1. Describe the life cycle of the yellow perch.
2. Discuss the factors that can affect perch populations at each stage of the life cycle.
3. Discuss the pros and cons of some methods used to manage the Lake Erie perch population.

SUGGESTED APPROACH

Activity A is designed for groups of 2-4 players, each with a set of game materials.

For Activity B students work in groups of 6, with each student having a different role. "Extra" students should be assigned the Fish and Wildlife Service role and placed as the 7th member of other teams.

ACTIVITY A

WHAT CAN HAPPEN TO A GROWING PERCH?

Keywords: spawning, commercial fishing, sport fishing population.

PROCEDURE

It will be necessary for you to construct the game materials using back pages of this guide. These pages can be cut out as they are, or they can be glued to cardboard sheets and then cut out.

Rules for playing the game are explained in the student guide booklets. Twenty to thirty minutes are needed to play the board game the first time. Students may want to play again, and a second round can usually be finished during the same class period.

Have each student complete the summary chart and answer the questions in the guide booklet. The summary chart may need some clarifying information that you can provide. For instance, some of the factors affecting perch may be considered either natural or man-made. An algae bloom may occur naturally with seasonal changes, or it may be induced by phosphates being added to lake water. Diseases likewise may be caused by nature or by humans' effect on the water. The stocking of pike in the lake, by people, has the effect of reducing perch populations by the natural process of predation.

A sample summary sheet is attached. It is intended to serve as your guide only, not as a list of "correct" answers. They may, for example, wish to list predators separately (kingfishers, pike, etc.) Discussion of possibilities will contribute to student understanding of the concepts in the activity.

NOTE: The numbers used in the game <u>reflect</u> reality, but are obviously not exact. They were chosen to allow reasonable simple mathematics while giving an indication of the relative impact of the various factors affecting the perch population.

1. Laying many eggs is an adaptation for the perch's survival. There are many hazards to the developing perch, and beginning with large numbers helps to insure that at least two fish will survive to replace the parent fish.

2. Largest losses occur among eggs and fingerlings. Be flexible in accepting other student answers. Students may attempt to add up all losses at each stage rather than responding intuitively with this answer.

3. Sexual maturity occurs at about 3 years of age (20 cm long).

4. Most mature perch are claimed by commercial and sport fishing.

5. From the game, perch numbers are increased by stocking, regulation of fishing, and creation of new spawning grounds. Students may be able to think of other ways.

ACTIVITY B — HOW CAN THE PERCH FISHERY BE MANAGED?

PROCEDURE

Keywords: fishery, optimum sustained yield, harvest.

The instructions for the simulation activity are complete within the Student Guide. Each student should get a copy of one of the six role descriptions included in the Teacher's Guide, pages 4-19. Arrange the classroom to facilitate discussions within the groups of 6 or 7 students.

This activity requires students to think about their roles for a time before the actual simulation begins. Distribute role descriptions to be studied overnight. The simulation itself can be completed in 1½ class periods, with time allowed for discussion. It is best to keep your own participation in this activity to a minimum, unless students have difficulty interpreting the demands of their roles. During the follow-up discussion, encourage students to analyze their own performance and the feelings they really have about why and how to manage a natural population. Answers to questions in the Student Guide will vary according to the FWS decision.

PAT TRAPPER
U.S. Fish and Wildlife Service

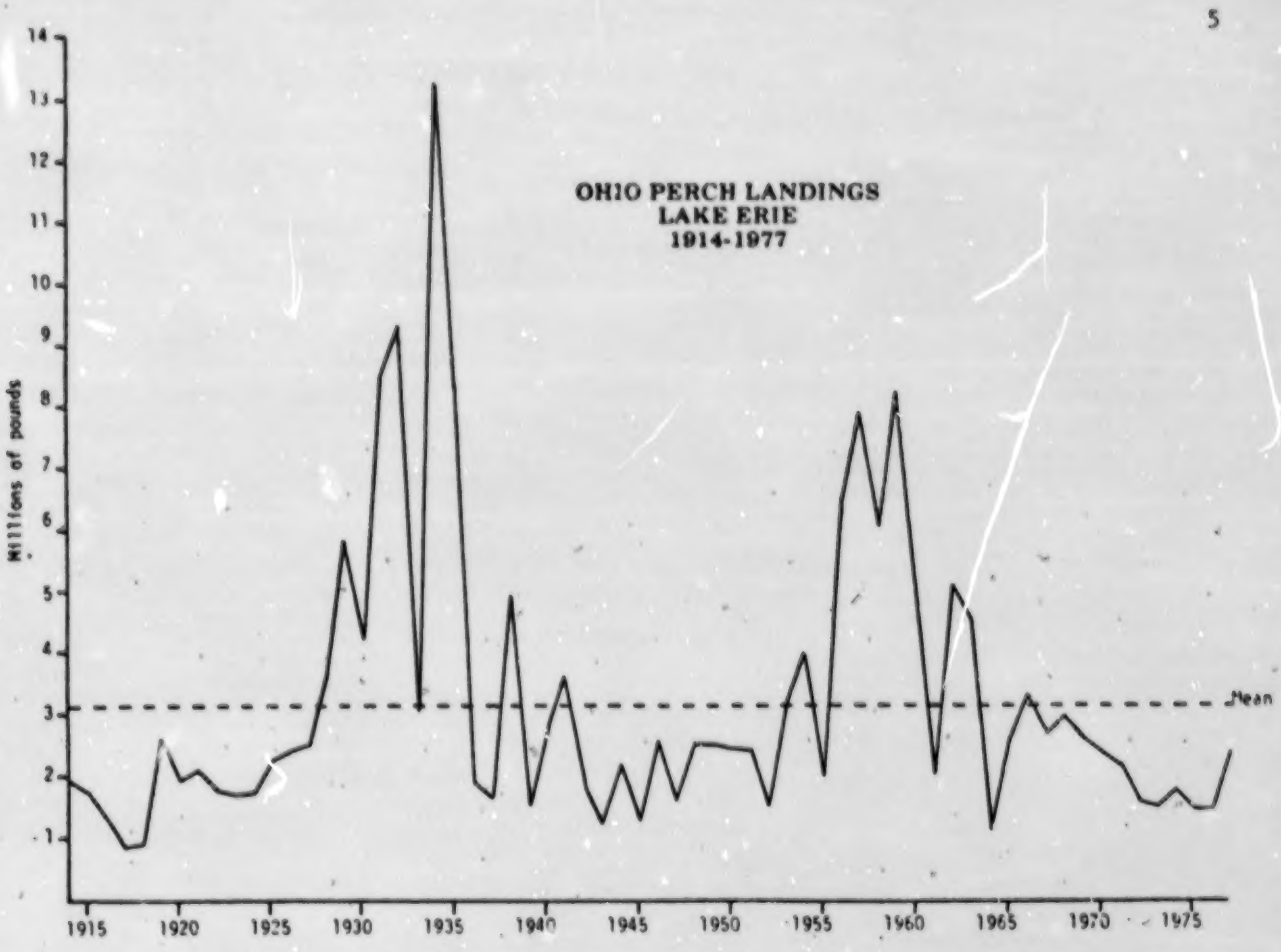
As a biologist and representative of the Fish and Wildlife Service it will be your responsibility to inform the public about what is being done and what needs to be done to manage the perch fishery in Lake Erie. The term fishery refers to the industry or occupation of catching, processing and selling fish. As far back as the 1860's the perch fishery was very active, especially on Lake Erie. By the late 1950's, perch was the number one commercial fish taken from the lake.

Sport and commercial fishers alike value the perch for its delicious, flaky white flesh. As the fishery manager, your goal is to work toward an "optimum sustained yield" of perch. Yield refers to the number of fish caught (harvested.) Optimum means the most or the biggest possible, with all factors considered. An optimum yield of perch is the best number to catch each year without interfering with the normal workings of the population or with other populations in the lake. If this best number can be repeated in the harvest over the coming years, it is said to be a sustained yield. The goal for Lake Erie, then, is to develop regulations that will allow the optimum number and weight of perch to be harvested each year.

Perch are harvested by two groups, the commercial fishers and the sports fishers. On Lake Erie there are about 1,000 people employed by the commercial fishing industry. They catch 35-40 million pounds of fish each year and sell the fish for almost $10 million. One-fourth of the fish caught are perch. These are processed into fillets (boneless strips of flesh from the sides of the fish) which are sold mainly in the large cities around the lake.

Sport fishing on Lake Erie is a major attraction for thousands of Ohio anglers. There are no regulations governing perch fishing for sport in the state. People can fish in any season and keep whatever perch they catch. In 1978, Ohio sport fishers caught 2,317,000 pounds of perch in Lake Erie. This was about 20% of all the perch taken in the lake that year.

The perch harvest in Lake Erie has been declining for the last few years (see graph on following page), and anglers are becoming alarmed. They have called upon your agency to produce a management plan that will increase the population of perch available for harvest. Your knowledge of the perch's life cycle and the hazards to the developing perch population have led your agency to consider two possible ways of dealing with the fishers' demands:



Ohio Department of Natural Resources, Division of Wildlife. Publication 200: "Commercial Fish Landings, Lake Erie - 1977."

1. Increase the survival rate at the egg stage by:

   A. Recommending a ban on construction along the lake shore within ½ mile of the lake, thus preserving existing spawning grounds.

   B. Recommending that industries that use water for cooling must limit the temperature increase in that water to 1°F, since spawning and hatching depend on water temperature.

   C. Preventing dredged materials from being dumped back into the lake where they would cloud the water and possibly spread dangerous pollutants.

2. Increase the annual harvest by:

   A. Delaying the start of the commercial fishing season until June 1, when spawning will be over.

   B. Allowing commercial fishers to use gill nets from October 1 to December 10 to catch perch 20 cm or longer. Gill nets result in a larger catch than the trap nets now used.

   C. Banning commercial fishing within one mile of the shoreline, so sport fishers will be able to catch more.

These two proposals are not the only possible answers to the perch decline problem, of course. They certainly will not satisfy all the people that will be affected. It will be your job to explain why both proposals are good ones. If other suggestions are presented, lead your group to consider whether they are useful or not. The group may wish to prepare a third proposal for the FWS to consider. If you favor one proposal or another, hold your opinion until others have presented theirs. As the most knowledgeable member of the group, where perch are concerned, your opinion should be well thought out, for your judgment is highly respected.

When your group has agreed on a management plan, it will be your job to meet with other FWS representatives and arrive at a decision that will satisfy as many of the public's demands as possible. Report your decision in a public hearing and predict how your management plan will provide an optimum sustained yield of perch.

DR. J. E. GILLMAN
STP (Save the Perch)

You are a professor of ecology and ichthyology at Clearwater University. As head of your department you have watched Lake Erie go from a lake that supported trout to one that barely supports the fish living in the lake now. You want to keep perch as a game fish and as an important link in the ecosystem that makes up the lake. In order to keep the perch going in the lake, you want the Fish and Wildlife Service to protect the 18,000 acres of marshes along Ohio's lake shore. This will serve

1. to preserve the perch breeding grounds and

2. to provide habitat for the waterfowl and other birds that are a vital part of the area.

You want the people to understand that what affects one area of the lake will affect all areas. The areas that you want to protect serve many functions, such as preservation of fish and wildlife, barriers to wind and wave erosion of the shore, natural water purifiers, natural flood control, and traps for the sediments that are carried into the lake by streams.

Who's Minding the Shore? Office of Coastal Zone Management, Washington, D.C.: National Oceanic and Atmospheric Administration, 1976.

The future of Ohio's Marshlands?

Beyond all this, you want to get the population of perch higher than it is now in order to restore the natural balance of the lake. This would require a 2-year ban on perch fishing, followed by stronger fishing regulations in later years. You want gill nets to be outlawed throughout the lake after the 2-year period. You also want sport fishing to be regulated by season and bag limit (only letting them catch a certain number of perch), and you want perch fishing to be done only with particular kinds of lures, such as spinners.

The nuclear power plant that has just begun operation on the lake is threatening the perch in another way. The plant pulls water from the lake to cool its machinery. Screens cover the openings of the intake pipes, but baby perch can be sucked through the screens and into the pumps where they are "entrained" and killed. A single large power plant on Lake Erie can entrain nearly 3,000,000 baby perch in one year.

Power plants around Lake Erie.

In addition to protecting spawning grounds and regulating fisheries, then, some drastic measures are needed to prevent further loss of perch to industries and power plants using lake water. Think about what could be done and try to get your ideas included in a compromise proposal.

Questions to consider:

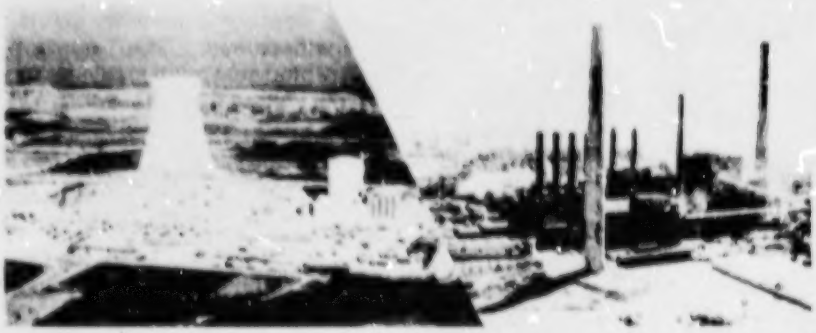
1. Which of the propositions proposed by the Fish and Wildlife Service do you favor?

2. What are you willing to give up in order to have as many of your ideas go through as possible?

POWER PLANTS ... AND WATER USE

The Great Lakes are a huge natural reservoir containing six quintillion gallons of water. This makes them a mighty attractive site for electric power generating facilities. Thermal plants, both nuclear and fossil-fueled, use steam to drive the turbines which generate our electricity. They require the cool lake waters to remove the waste heat from the power generation equipment.

How much water do these plants use? As the largest water users in the state they use nearly three-fourths of the 17 billion gallons of Ohio's daily water consumption. A typical 290 megawatt fossil-fuel plant uses 160,000 gallons per minute. If the plant uses a once-through cooling system, as most fossil-fuel plants now do, only a very small amount of this water is lost through evaporation inside the plant. About 99% is returned to the source from which it was diverted. But this water, because it has taken heat from the steam, is about 5F° warmer than it was.



Use of cooling towers such as the one at Davis-Besse will soon be required in order to lessen this "thermal pollution." But in a cooling tower, the heat is transferred to the air through evaporation. Thus a larger amount of water is lost. A power plant with a cooling tower will pass about 15 million gallons of water in the form of steam into the atmosphere each day. A cooling tower also needs water for "blowdown" or removal of accumulated solids from the cooling water.

Ohio's streams, except for the Ohio River, cannot afford such water loss. Thus the continued use of Lake Erie (with 12.5 quadrillion gallons) and the other Great Lakes for energy facility sites is an inevitable part of our future.

The Beacon. Ohio Coastal Zone Management Newsletter. Winter 1977.

FACTORS AFFECITNG PERCH

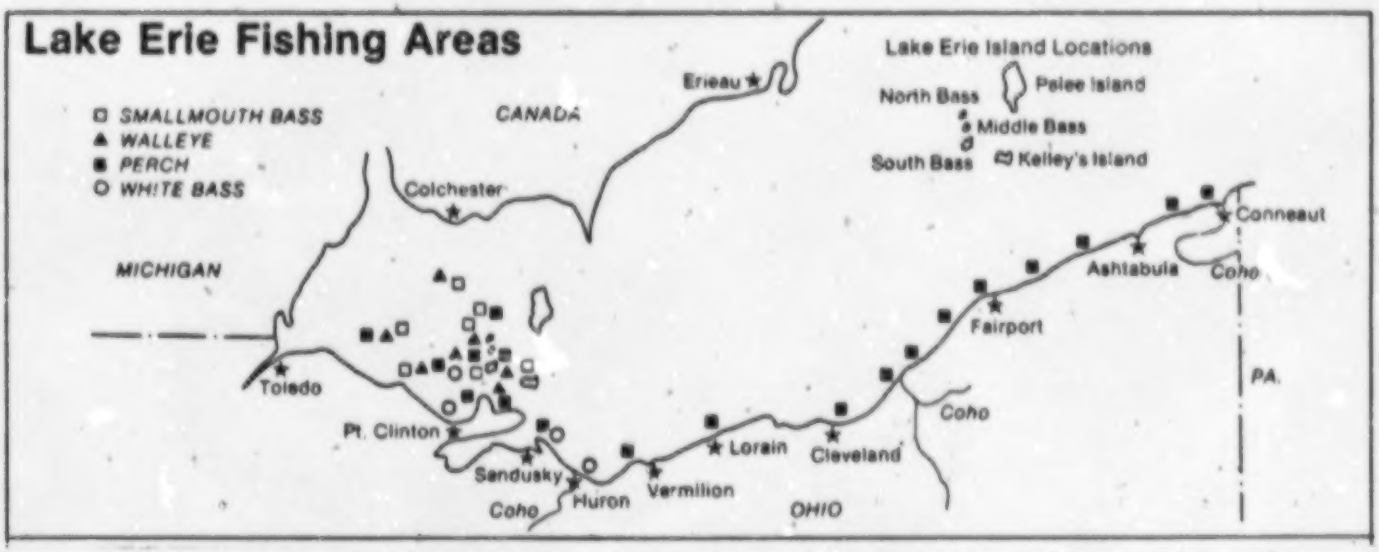
Stage of Life Cycle	Natural Factors	Add(+) or lose(-) population	Man-made Factors	Add(+) or lose(-) population
Eggs (use no CHANCE cards)	*Flood	-	*Herbicide *Construction on shore *Power plant	- - -
Young Perch (hatching to 2 years)	*Predators *Rainy spring season *Storms *Disease	- + - -	*Herbicide *Power Plant *FWS stocking *Algae bloom *Oil spill *Sewage plant failure *Entrainment	- - + - - - -
2-3 Year Old Perch	*Fungus *Disease *Predators	- - -	*Construction on shore *Gill nets *Algae bloom *Oil spill *Sewage plant failure *Impingement *Stocking by FWS	- - - - - - +
Mature Perch	*Disease	-	*New fishing lure *Marshes filled in *Chemical dump *Algae bloom *Oil spill *Sewage plant failure *Impingement *FWS stocking	- - - - - - - +

"ACE" ANGLER
Sport Fisher

Ever since you were no more than a fingerling yourself, you've been fishing in Lake Erie. Your dad has told you what it was like to catch enough blue pike in an hour to last for two whole weeks. Your grandfather can remember catching a muskie or two. Now most sport fishers go after walleye, which are food fighting fish. You caught a walleye once, but for a good big catch you prefer perch. You once caught 100 perch in 3 hours!

Perch fishing is exciting in its own way. A perch doesn't fight much, but there is a trick to hooking one. The perch nibbles at the bait, and it takes an experienced hand to set the hook before the bait is stolen. When you've caught a good sized perch (20 cm or longer) you have a nutritious meal. Besides its excellent flavor, perch has more protein and less fat than beef, pork, or poultry.

Since you are a business person by profession, you have little free time to devote to fishing. You appreciate the facts that you are not limited to a certain season for catching perch, and you can keep as many as you catch. Ice-fishing around the islands is particularly enjoyable, but there are many good fishing areas all year round.



Ohio Department of Natural Resources, Division of Wildlife. Publication 137: "Lake Erie Fishing Services and Facilities."

The commercial fishers are now getting 80% of all the perch caught in Lake Erie. As a sport fisher you would like to get a bigger piece of the action. These facts may help you.

A. A resident sport fishing license costs $7.75. In 1979, the State of Ohio will make about $8,000,000 from the sale of these licenses. You are providing the state with a lot of money, and in return you have a right to get something for it (more fish).

B. You have found that fishing near a power plant is great because the warm water has lots of food in it to attract fish.

C. If commercial fishers get to use gill nets, they will be able to catch even more perch. (Commercial licenses provide only about $65,000 a year in state revenues).

Questions to consider:

1. Which of the Fish and Wildlife Service proposals do you favor?.

2. What are you willing to give up in order t have as many of your ideas as possible accepted?

SANDY SHORES
Urban Development League of Ohio (UDLO)

You represent an agency committed to developing the Lake Erie shoreline for the benefit of the state. Each year millions of tourists travel through the Great Lakes areas. More lakeside motels, amusement parks, and scenic highways would capture more tourist dollars for the state. Private individuals are also looking for lakeshore property for vacation homes. More than ¼ of Ohio's population lives in the eight counties bordering Lake Erie, and more people would come if they had places to live. There are dozens of contracting companies just waiting for UDLO to give them the go-ahead signal so they can begin a massive construction effort and make Erie's shore a real showplace.

There are some problems, however. First, such developments require massive earth-moving efforts. There must be dredging for marinas, scraping for roads and parking lots, and piling for landscape purposes. Some of your contractors have not taken proper erosion control methods in the past, and they have been responsible for some bad erosion problems. You must try to overcome their bad reputation by promising strict rules for erosion control. If such heavy erosion occurred on the lakeshore, the lake would be muddy and nobody would want to visit there.

The law requires that Lake Erie ports be dredged each year to maintain a depth of 28 feet so freighters can dock. This is one of UDLO's responsibilities. Ordinarily, dredged materials are dumped in diked areas in the lake, where they eventually form new islands. Fishing is great around islands, so the sports fishers should be attracted to these areas. The FWS, however, is proposing that dredged material be dumped inland. This would be very expensive and difficult to manage.

Finally, the Fish and Wildlife Service wants to ban construction within one-half mile of the lakeshore. This would spell disaster for UDLO's plans. People come to Lake Erie to see the lake and play around it. If they have to hike one-half of a mile from their motels, they probably won't even bother to come. What kind of scenic view can you get from that far away? It would be a terrible mistake to let this measure pass. The state would lose millions of dollars in tourist trade and property taxes without shore development.

Questions to consider:

1. What changes in the proposals will you recommend?

2. What are you willing to give up in order to get most of your ideas accepted?

TOLEDO-LOOKING TO HARBOR REVITALIZATION AND PUBLIC ACCESS

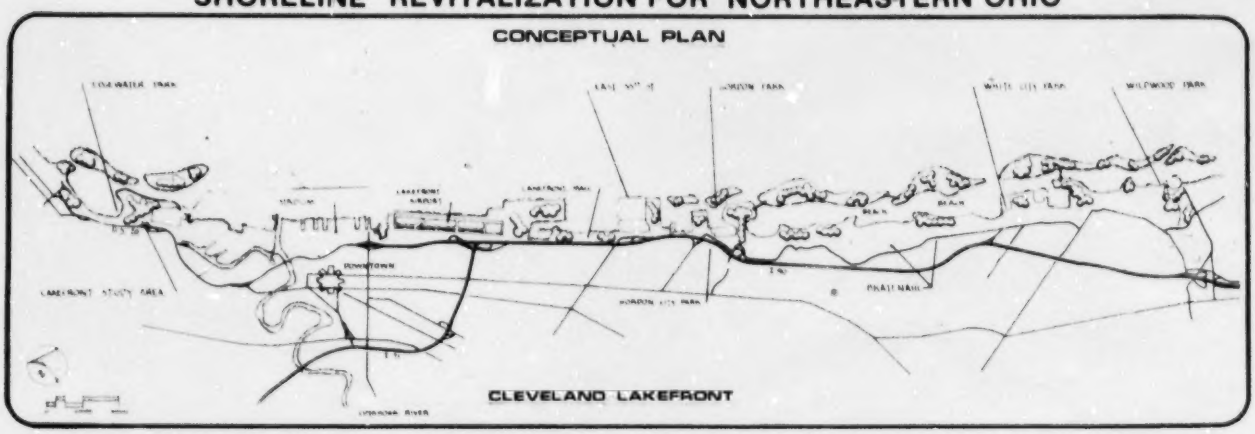
Lake Erie's busiest, the Port of Toledo, has long served as a vital part of that City's economy. The port developed and expanded quickly into its present 4,000 acre complex with little regard for the riverfront's immense potential for other uses. But Toledo's eight mile riverfront and its value for recreation and public access are now being rediscovered. Several actions have recently been initiated by the Toledo-Lucas County Plan Commissions to cope with the issue of balancing uses along the riverfront.

Toledo's innovative Maumee Riverfront Overlay Zoning District (MR-0 District) reflects the city's commitment to regarding the riverfront district as an area of unique importance. Passed by Toledo's City Council last winter, the regulations which establish the district seek to "provide for maximum public benefit from the further development of the riverfront areas, through a combination and sharing of uses." These include commercial, residential, industrial, recreational and transportation land uses.

The Beacon. Ohio Coastal Zone Management Newsletter. Winter, 1978.

The Beacon. Ohio Coastal Zone Management Newsletter. Winter, 1977.

SHORELINE REVITALIZATION FOR NORTHEASTERN OHIO



Lake Erie has historically supported an incredible diversity of water oriented recreational activities. However, if Ohioans are to enjoy the benefits that can be provided by leisure activities associated with the lakefront, a revitalization is needed, particularly of the existing park areas. The proposed Cleveland Lakefront Park will hopefully provide the stimulus needed for a renewed effort directed toward this valuable resource of the state.

There is little question that the Cleveland metropolitan area has a high demand for parklands but has a very inadequate supply. The problems associated with reduced funding for operations and maintenance have further compounded the problem, by allowing existing city park areas to deteriorate.

Four shoreline parks (Edgewater, Gordon, White City and Wildwood) provide excellent recreational potential, but all presently suffer from unsightly dumping, misuse and lack of proper access and maintenance. Preliminary studies by ODNR's Office of Outdoor Recreation Services recommended improved picnicking, boating facilities, fishing access, swimming and more "green-space" and landscaping. Man-made, offshore islands if implemented could provide additional acreage for such uses in addition to acting as a buffer to reduce shore erosion.

The preliminary studies have addressed in a general way the means for meeting state objectives and dealing with general problems involved in developing a state recreation area. The conceptual plan prepared by ODNR will be used as a starting point for further detailed consultant planning. The consultant will study the specific problems involved in the development, and recommend courses of action for implementation.

The Coastal Zone Management Section will perform a coordinative function by reviewing Lakefront Park plans once they are developed. Review will be for consistency with Coastal Zone Management objectives.

TERRY WATTS
Consolidated Ohio Power

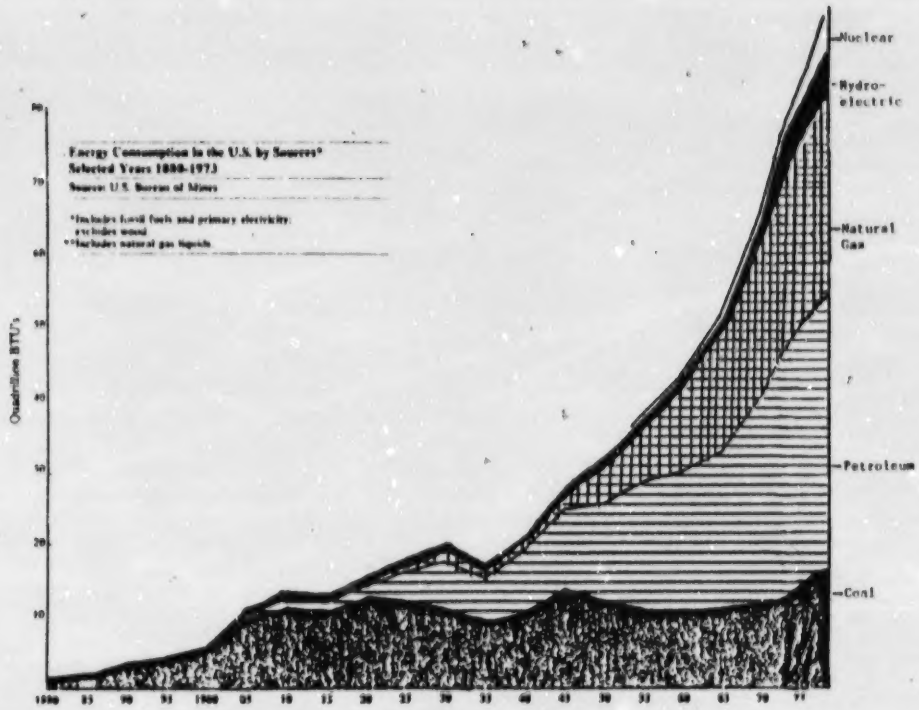
You are the plant manager of the Water Hole Power Station on Lake Erie. Water Hole is a 20 year old fossil fueled (coal fired) power plant capable of generating 600 megawatts of power. It has a once-through cooling system, meaning that it draws in water from the lake, uses this water to cool its steam condensers, and then discharges the water directly back to the lake. This also means that Water Hole does not have a cooling tower. It uses over 500,000 gallons of water per minute (gpm), which it discharges 15° warmer than it was when it entered the plant.

Water Hole is in a rapidly developing area. Low cost electric power is essential to allow this development to continue. In fact, the area has developed so rapidly that Consolidated Power can no longer supply the demand with its three power plants and must now purchase power from Detroit Hydro, a neighboring company. Last spring you attempted to get a 15% rate hike to allow purchase and initial construction of a new power plant. The Public Utilities Commission allowed only a 10% increase and this was hard to get.

You have an "impingement" problem at Water Hole. During the winter, large numbers of gizzard shad come in the intake canal and are trapped against screens which are placed in the canal to remove large fish and debris. These would damage the internal workings of the plant if they were allowed to go through it. Last year so many fish piled up on these screens that no water was able to pass and you were forced to shut down Water Hole. Damages amounting to $100,000 resulted when the screens were smashed by the pressure of the fish and water. You would like FWS to tell you an inexpensive method to alleviate this problem, but they are not doing any research in this area. They have made several suggestions, most of which cost over $1,000,000 and are not guaranteed to be successful. These costs would be passed on to consumers, and the public is already upset over energy costs.

FWS has found that you also have an entrainment problem at Water Hole. "Entrainment" refers to the fish eggs and larvae (fry) which are carried along (entrained) in the intake current. They are killed by hot water in the plant. FWS estimates that during a single spawning season Water Hole kills 3,000,000 fry.

If FWS requires you to reduce the temperature of your discharge to 1°F above the intake temperature it will be necessary to install a cooling tower. This tower would reduce your entrainment and impingement problems by 95% since your intake volume would be reduced from 500,000 gpm to 20,000 gpm. However, this tower would cost between $20 and $35 million and would reduce your net power output from 600 megawatts to 550 megawatts. All these costs would be passed on to consumers, raising the average monthly electric bill by 25%. You feel this is unacceptable and unfair, especially to the many consumers in your area who are not fishermen and who do not eat perch or use Lake Erie for recreation.



from Erickson and Sherman, Energy in the Classroom, Vol. III, 1975.

The graph above shows how energy use is increasing year by year. It is unlikely that energy use will ever drop off, but conservation measures may level it off at the present high rate. Coal provides only a small amount of our energy, yet Ohio produces millions of tons of coal each year. You believe we should support local industry by using more Ohio coal, not by imposing restrictions that discourage its use. FWS proposal 1 makes power production more expensive. You would favor some proposal that would lessen your costs, not raise them.

Questions to be considered:

1. Which proposition do you favor?

2. What are you willing to give up (compromise) in order to get what you want?

LAKE ERIE AT AN ENERGY CROSSROADS

Energy has been, for several years, one of the stickiest problems facing our country. With oil embargoes, trans-Alaskan pipelines, nuclear fusion breakthroughs, record cold winters and the creation of new Departments of Energy at the state and federal levels, it's one of the hottest news items as well. To a Lake Erie resident, problems and conflicts regarding energy often seem to peak and then fade with time. But if the issues at times seem as far away as Saudi Arabia or Prudhoe Bay, consider the following:

- Of Ohio's six nuclear units now operating or under construction, five are on Lake Erie; of the additional three units planned, two are in the lake region.
- The possibility of drilling for natural gas under Lake Erie is being considered anew by the General Assembly.
- Pittsburgh researchers are looking at the feasibility of offshore wind energy generation systems in the Great Lakes.
- Fifteen million gallons of Lake Erie's water evaporates every day from each cooling tower in use.
- A $100 million coal gasification demonstration plant is planned for Lorain's west side, in the coastal area.

Ohio and Lake Erie are involved at an energy crossroads both geographically and chronologically. Tough decisions will be necessary in the upcoming years.

The many uses of Lake Erie's coastal area for energy raise serious environmental, social and public health questions. Construction at major utility sites can cause greatly increased sedimentation, degrading water quality and hampering recreation and fish habitats. Land use development and traffic patterns

can be disrupted in unpredictable ways. And public fears regarding the hazards of nuclear wastes have not been allayed. On the other hand additional electrical energy must be provided if we are to reduce dependence on foreign oil.

Dealing with energy problems in the Lake region is one aspect of Ohio's Coast Zone Management Program. Seven Lake Erie communities will be studying means to alleviate impacts from energy development through the Coastal Energy Impact Program (CEIP) administered by the Ohio Department of Energy. The program will bring over $400,000 to the county and regional planning agencies from the federal Office of Coastal Zone Management (OCZM). Projects will include analysis of the impacts of Davis-Besse and Perry nuclear power plants in Lucas and Lake counties, a study of alternate energy sources and natural gas transmission in the eastern counties, and an assessment of actions needed to bring Lorain's proposed coal gasification plant in line with air quality standards.

Ohio's CZM Program staff, as a part of its draft plan, has developed a set of policies and proposed implementation methods for improving coastal energy facility siting processes. Most of these policies involve considering additional concerns in the Ohio Power Siting Commission's (OPSC) review process. Visual impacts on the shoreline and inappropriate use of the shoreline by non-coastal dependent energy-related facilities are to be addressed. Concerns of the CZM Program will be addressed within the OPSC through representation by the Director of the Department of Natural Resources. Additional coordination will also be developed with Ohio's Department of Energy. In all, a stronger voice for coastal concerns will result throughout energy planning processes.

CAPTAIN FISHER
Representative of Fishing Fleet and Buyers Co-op

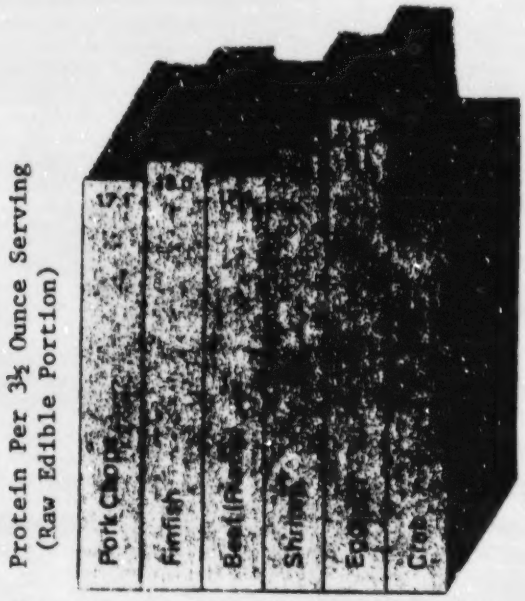
Your father fished in the same boat you do, and you took over his business when he got older and retired. When your father left you the boat and nets he told you to always stand behind the co-op and help other fishers as much as possible. The fishing has not been good the last few years because the Canadians have been taking all but 10% of the perch catch with gill nets. You cannot use gill nets because they are outlawed in U.S. waters of the western basin. You want the Fish and Wildlife Service to permit you to use gill nets. Since you know the best-selling perch are the bigger ones, you are willing to settle for a kind of gill net that will let other perch through and will catch only those over 8 inches long. The season now lasts from March 1 to December 10. You want to extend the fishing season so that you can catch more fish. Because all this will lower the number of fish in the lake, you want the Fish and Wildlife Service to stock more perch in the lake. If all goes according to plan, the price of perch will go up. Last year you made only $8,000 from fishing. You need this money to buy new nets and to over haul your boat. If you do get all of these things done then you can catch perch for the new Wendy's Perchburger.

You need to know this information:

1. The fish processors in your organization are pushing for such greater use of Lake Erie fish in Ohio. To bring fish from Maine or Florida is very expensive, and lake fish have the same flavor and nutritional value as the "imported" types. Notice how fish compare with other foods:

Calorie Comparison

Protein Comparison



"Vitalize Your Life--Discover Seafood." National Marine Fisheries Service, Washington, D.C.: National Oceanographic and Atmospheric Administration, 1978.

2. Perch is the most important commercially caught fish in Ohio. Perch fishing means a lot of money for local areas.

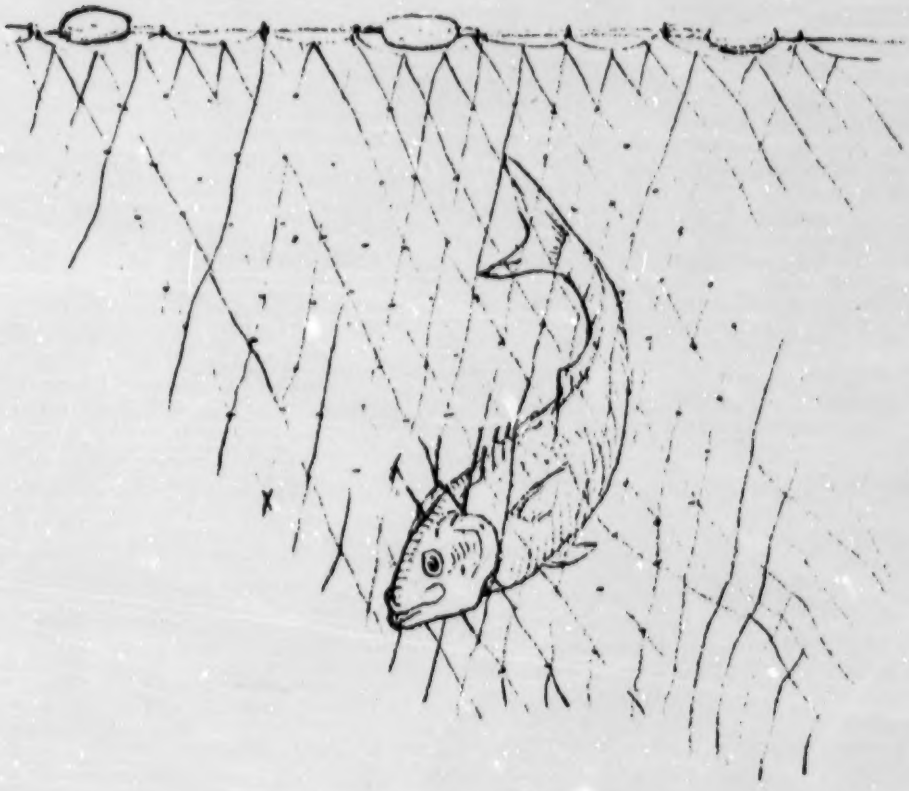
3. Canada supports its commercial fishery and therefore the Canadians are catching 90% of all the perch taken from the lake. The FWS should support U.S. fisheries so we can receive the same benefits.

4. Fish caught locally will cost consumers less than fish from the ocean. People would eat more fish and be healthier if fish didn't cost so much.

Questions to answer:

(1) Which proposition do you favor?

(2) What are you willing to use to bargain in order to get the things you want?



Gill Net

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Who's Minding the Shore? Office of Coastal Zone Management, Washington, D.C.: National Oceanic and Atmospheric Administration, 1976.

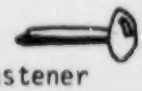
GAME BOARD GLOSSARY

1. dredge - to dig out the bottom of a waterway in order to deepen the water.
2. fertilization - the uniting of male and female sex cells (sperm and eggs).
3. fillet - to cut out the strips of fish flesh along the fish's spine.
4. fingerling - a young fish, about the length of a finger.
5. gill net - a net made of fine threads that entangle a fish's gills.
6. herbicide - a chemical that kills plants.
7. heron - a large shore bird that eats fish.
8. kingfisher - a bird that eats small fish.
9. marina - a place where small boats are docked and serviced.
10. mature - able to reproduce.
11. spawning - the depositing of eggs by fish.

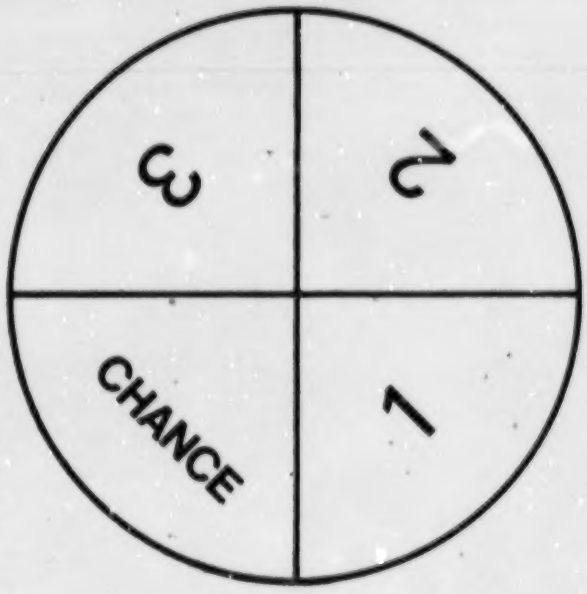
SPINNER

Cut out the spinner and paste it on a piece of cardboard. Punch a hole in the center and put a paper fastener through the hole so it will hold the paper clip and allow it to spin.

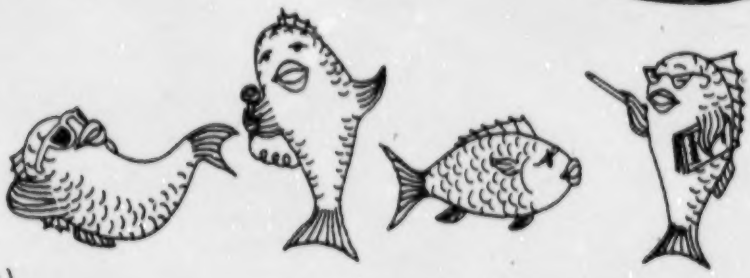
Paper clip



Paper fastener



PLACE-MARKER TOKENS (Cut out and color)



CHANCE CARDS (cut apart)

Fish and Wildlife Service stocks 20,000 new perch in the lake.

Add 5,000 of these to your population.

Perch-eating pike are stocked in the lake. Lose all but 1,000 of your perch if they are smaller than 23 cm.

Sport fishing banned this year because of low populations.

Take another turn.

Excellent growing conditions this year.

Take another turn.

Pesticides kill zooplankton and aquatic insects. Lose 1 turn while your fish move to new feeding areas.

Algae bloom results in a temporary abundance of food. (Perch eat zooplankton which eat the algae.)

Take another turn.

The legislature establishes a perch fishing season (5 months) instead of allowing year-round sport fishing. KEEP THIS CARD; it will cancel your next loss of perch.

Wastes from a chemical industry stunt the growth of your population.

Lose 1 turn.

Heavy storms affect perch population. Wave action and habitat destruction kill 500 fish less than 15 cm. long. If your fish are larger they survive.

A rainy spring season raises the lake level, and flooded shores create new spawning grounds. Each perch population under 15 cm. gains 2,000 fish.

Sports fishermen develop a new, more effective lure. If your fish are more than 23 cm. long, 500 are caught.

Shoreline marshes filled in for new homesites. Half of your population will not find suitable spawning grounds. If your fish are under 3 years old this card has no effect.

Commercial fisheries can now use a new sonar to find schools of fish. Lose 750 of your perch population if they are over 15 centimeters long.

A parasite infects your population. Males are only weakened, but most females become sterile. Only 100 of your female perch are now able to spawn.

Algae blooms cut down on available oxygen by respiration and decomposition.

1,000 fish die in all populations.

Disease weakens your perch population.

All but 1,000 die.

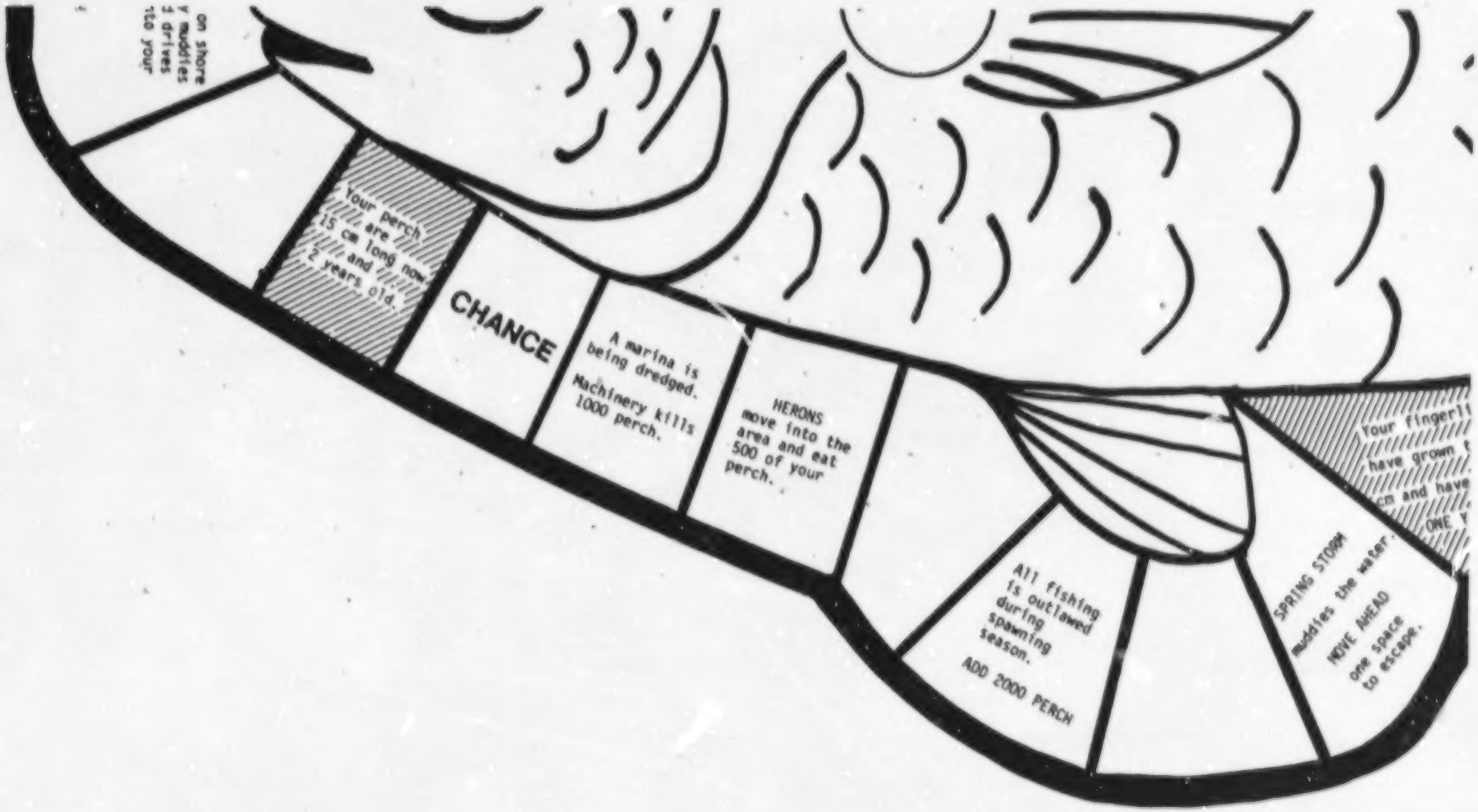
An oil tanker breaks up in a storm and all but 500 of your fish die from the oil spill.

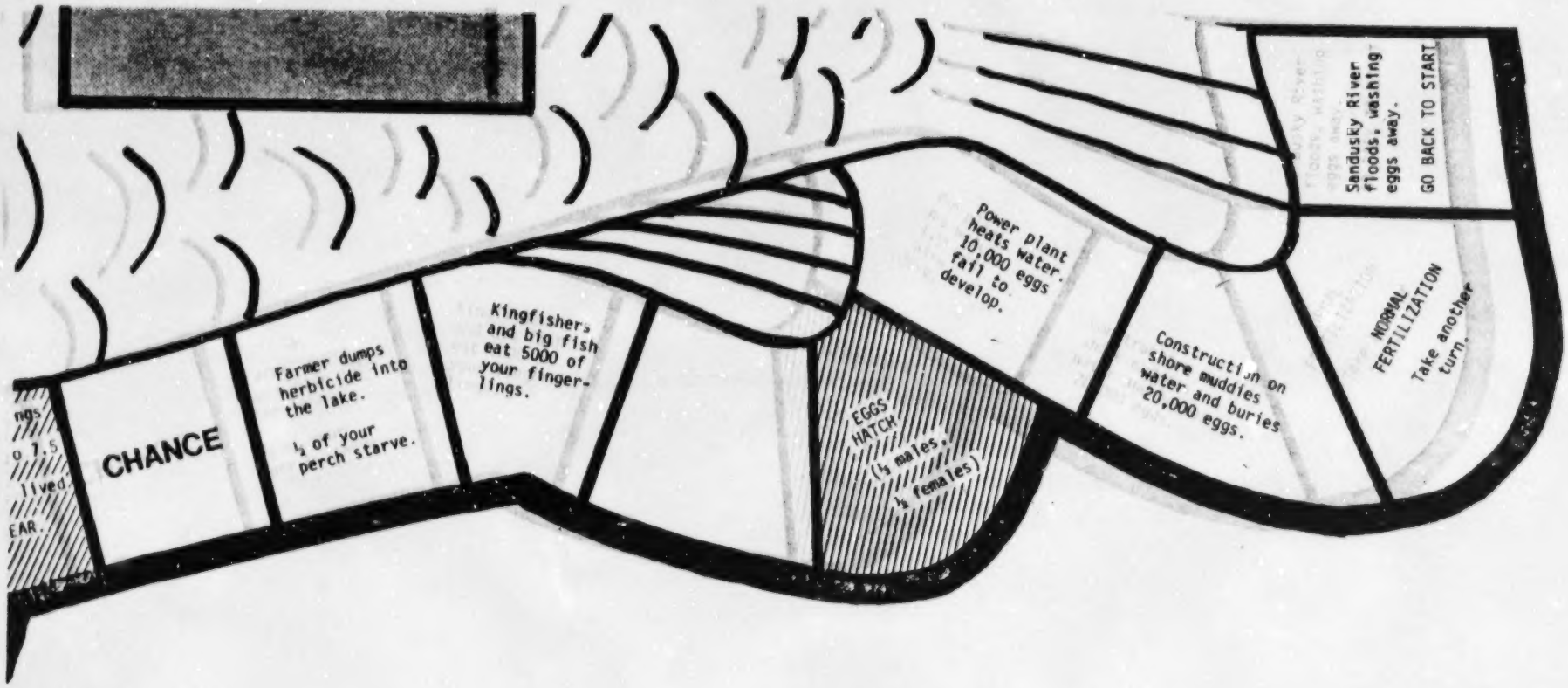
Sewage plant fails. Wastes in the water use up oxygen, killing half of your perch population.

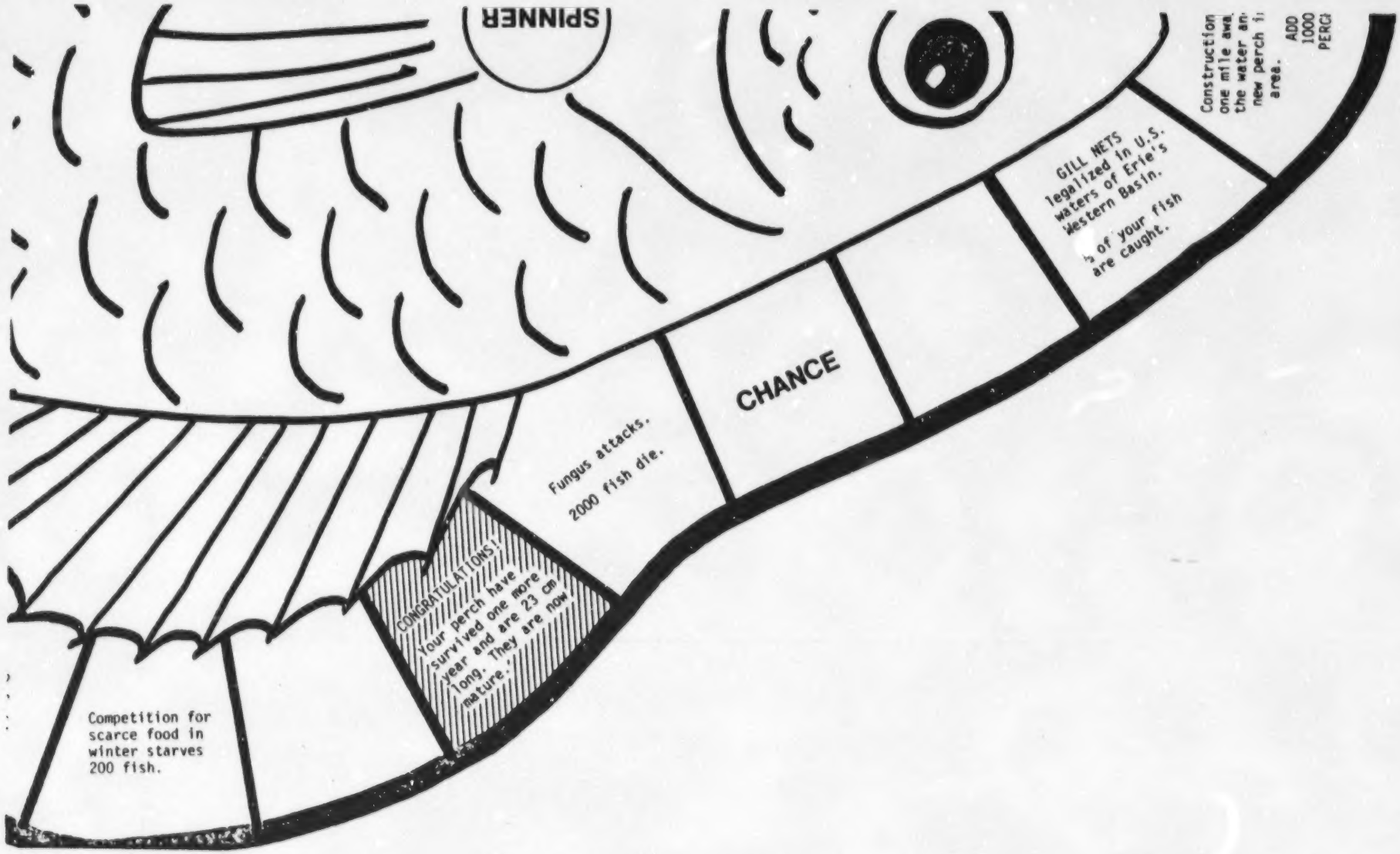
A power plant pulls lake water in to cool its machines. If your perch are less than a year old, 5,000 are sucked up. 1,000 perch over 1 year old are trapped at the intake pipes and suffocated.

SAVE THIS CARD !!!

Coast Guard cleans up oil spill. You lose only half of your fish.


on shore
y muddies
s drives
tle your
Your perch
are
15 cm long now
and
2 years old.
CHANCE
A marina is
being dredged.
Machinery kills
1000 perch.
HERONS
move into the
area and eat
500 of your
perch.
All fishing
is outlawed
during
spawning
season.
ADD 2000 PERCH
SPRING STORM
muddies the water.
MOVE AHEAD
one space
to escape.


CHANCE
Farmer dumps herbicide into the lake.
½ of your perch starve.
Kingfishers and big fish eat 5000 of your fingerlings.
Power plant heats water. 10,000 eggs fail to develop.
EGGS HATCH
(½ males, ½ females)
Construction on shore muddies water and buries 20,000 eggs.
NORMAL FERTILIZATION
Take another turn.
Sandusky River floods, washing eggs away.
GO BACK TO START


SPINNER
Construction
one mile awa
the water an
new perch f
area.
ADD
1000
PERCH
GILL NETS
legalized in U.S.
waters of Erie's
Western Basin.
½ of your fish
are caught.
CHANCE
Fungus attacks.
2000 fish die.
CONGRATULATIONS!
Your perch have
survived one more
year and are 23 cm
long. They are now
mature.
Competition for
scarce food in
winter starves
200 fish.

CHANCE
START
50,000 eggs are laid among water plants near the shore.
Water plants are killed by herbicide.
15,000 eggs are destroyed.
YOUR FISH HAVE MADE IT !
If you have one male & one female. SPAWN!
Long winter delays spawning.
Lose 1 turn.
Commercial fishers catch ONE-HALF of your perch.
Your perch reach MAXIMUM SIZE! (30-33 cm)
CHANCE
SPORT FISHING in full swing.
100 percent filleted or fried.
GOOD GROWING CONDITIONS
Take another turn.

EVALUATION ITEMS

1. About how many eggs does a female yellow perch lay?

   1) 150,000
   *2) 50,000
   3) 25,000
   4) 5,000

2. Which of the following is probably <u>not</u> a reason why perch lay a large number of eggs?

   1) There are many other fish that eat the perch.
   2) Many of the eggs do not hatch.
   *3) Lake Erie is a huge body of water and can support them all.
   4) The odds are against the survival of most of the perch.

3. Baby perch ("fry") survival is <u>not</u> affected by

   1) predators.
   2) water temperature.
   *3) fisheries.
   4) industries along the lake.

4. How could the survival rate of perch eggs be increased?

   *1) Dump dredged materials on land instead of in the lake.
   2) Use more water for industrial cooling.
   3) Add fertilizers to the water to provide more plants.
   4) Add herbicides to the water to get rid of some plants.

5. If a perch is <u>entrained</u> by a power plant or other industry, the fish is

   1) chopped up by machines in the power plant.
   2) pinned against intake pipes and suffocated.
   *3) killed by hot water.
   4) trapped for awhile, but then escapes.

6. If the lake level rises, how is the perch population affected?

   1) Population is unaffected.
   2) Population decreases because flood waters wash fish up on land.
   *3) Population increases because new spawning grounds are created.

7. When and why are water plants important to perch?

   1) They provide food for adult perch.
   2) They provide food for baby perch.
   3) They hold eggs in place until the baby perch can hatch.
   *4) Both 2 and 3.

8. The amount of perch in Lake Erie could be increased by

   1) allowing unlimited usage of gill nets.
   *2) putting a limit on the fishing season.
   3) encouraging construction along the shoreline.
   4) dredging out egg laying areas.

9. Fisheries management policies are affected by

1) industries.
2) commercial and sport fishers.
3) the U.S. Fish and Wildlife Service.
*4) all of the above.

10. What is optimum yield?

1) The best number of fingerlings to use to re-stock the lake.
2) The largest number of eggs that a female perch can lay.
3) The largest number of perch that a lake can support.
*4) The best number of perch to catch in any one year.